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REPORT

— OF —

Commander Folger and Lieut. Buckingham

— TO THE —

Secretary of the United States Navy,

— Upon the —

Nickel and Copper Deposits

Of Sudbury, Ontario.

OTTAWA, CANADA :
Free Press Book and Job Print, Elgin Street.
1898

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SIR,—

Permit me to add a few lines of preface to the Report of Commander Folger and Lieutenant Buckingham which here follows :

The production of nickel steel and other alloys of nickel, for warlike appliances of every kind and description, has become a matter of the greatest commercial importance and that importance has been greatly enhanced within the last few days by the immense sums appropriated by the Russian, English and United States' Governments for the strengthening of their navies.

The world's supply of nickel is limited to two localities, one in the district around Sudbury, in the Province of Ontario, and the other is on the Island of New Caledonia, in the Southern Hemisphere, east of Australia, in one hundred and sixty-five degrees east longitude and twenty three degrees south latitude.

At no other place and in no other country in the world has any nickel of any importance or commercial value ever been found.

As an alloy of nickel with steel now determines the value, strength and durability of steel, it also determines the strength, value and durability of a navy made of steel.

The power of a nation's navy is now determining her place and power in the commercial world.

It is a most remarkable fact that at the present time every great nation in the world desires to buy war ships, and it is still more remarkable that in no market in the world are any warships for sale.

Canada is the only country in the world which possesses both nickel and iron—what use has she made of these minerals? What use does she propose to make of them? These are very important questions. They are questions far more important than any commercial question before her Parliament or her Government. The importance of nickel and steel in a commercial way, was found out about ten years ago.

Members of Parliament have many times asked me : " Has Canada really got a supply of nickel sufficient to meet the wants of the world? Can she supply it as cheap or cheaper

than New Caledonia? Can Canada, by any means, have a monopoly of the production of this metal? Can she refine it in this country and mix it with her iron and produce nickel steel?" To every one of these questions we have invariably answered, yes. But I have been called upon for the proof of my statements, and I here offer it.

In 1890 General B. F. Tracy, the Secretary of the United States' Navy, after exhausted experiments, decided to adopt nickel steel for the use of the navy. But before doing so he said to me that he wished to assure himself that there was a sufficient supply of nickel at Sudbury, and that he wished to send his own commission of experts to Sudbury to examine all the deposits in that neighbourhood. He did send such a commission. That commission made a report to him and the following pages of this pamphlet constitute this report and I think are abundant proof of my statements that Canada not only has an inexhaustible supply of this metal but that she can produce it at a cost far below that at which New Caledonia can produce it and that she thus has a monopoly of the world's use of this metal. As will be seen by the last page of this report the Canadian Copper Company owns six hundred and fifty millions of tons of this nickel and copper bearing ore. The immense importance of these figures can be best understood when I state that this tonnage represents an amount more than five times as great as all the iron ore ever mined in the States of Michigan, Wisconsin and Minnesota from the opening of the first mine in any of these States until the present day, and more than thirty times as great as all the nickel to be seen in the whole of New Caledonia.

The Sudbury ores taken as a whole carry about equal parts of copper and nickel. They vary from two per cent. to thirty per cent. of nickel and from two per cent. to thirty per cent. of copper. They could be successfully worked either as copper or nickel mines, but they can be more successfully worked as both nickel and copper mines. But if they are to be of any benefit to Canada they must all be refined and manufactured in Canada. Thus far these immense deposits have been of little benefit to Canada and of no benefit to Canadians.

Canada's iron ore can be made of no use unless alloyed or mixed with nickel.

They cannot be alloyed or melted with nickel unless the nickel is refined in Canada so that the Canadian manufacturer of nickel iron or nickel steel can have his nickel at a price

as much cheaper than his American competitor, as the American has to pay for import duty upon refined nickel.

They never will be refined in Canada while the Government permits them to be exported in a crude state.

The whole question, therefor, depends upon the Government exercising the power taken at the last session of Parliament and placing an export duty of two cents per pound upon copper and ten cents per pound upon nickel in the form of nickel and copper mattes. No figures less than these will prohibit its export in the form matte.

The expense of producing matte at Sudbury has been greatly cheapened since this report was made seven years ago, but the extent of the deposits has not changed, and the working of the several properties since the making of the report has proven it to have been wonderfully correct.

The pamphlet which I have also sent you on "The Question of Export Duties on Nickel and Copper Mattes," will show you that Sudbury can produce nickel at about one half the price at which the New Caledonia Mines can produce it and lay it down in the markets of Europe or the United States, but I will not go farther. I ask you to read this report and when you have read it you will better understand from the highest official authority, the magnitude of the interest which Canada has allowed and is allowing to be wholly diverted from her own country.

S. J. RITCHIE.

Russell House, Ottawa,

March 21st, 1898.

REPORT OF

COMMANDER FOLGER and LIEUTENANT BUCKINGHAM

—TO—

The Secretary of the United States' Navy

—UPON—

The Nickel and Copper Deposits

OF SUDBURY, ONTARIO.

BUREAU OF ORDINANCE

NAVY DEPARTMENT, WASHINGTON, Oct. 14th, 1890.

HON. B. F. TRACY,

Secretary of the Navy, Washington, D.C.

SIR,—

In obedience to the Department's order of the 28th ultimo, we proceeded to Cleveland, Ohio, and on the afternoon of the 1st instant were received by the Board of Directors of the Canadian Copper Company. These gentlemen informed us that every facility would be afforded to us to see their properties in Canada, and the plant, progress and processes at their mines.

Mr. S. J. Ritchie, one of the Directors, was selected by the Board to accompany us, and he subsequently instructed the manager of the works to freely answer all our questions concerning the mines and the operations of the company at the various points under his management, and during our visit we found every indication of the desire on the part of the management and its employees to show us the exact state of affairs.

Wednesday night we left Cleveland. Arrived at Sudbury Friday afternoon in time to examine the mining operations at

the "Copper Cliff Mine." Saturday we visited the roasting beds and the smelting works at Copper Cliff, and were shown the indications of the line of ore deposits extending from the Evans to the McConnell mines.

The same evening we went to White Fish Station, on the Algoma branch of the Canadian Pacific Railway, and the next day visited the deposits Crean hill range and the Vermillion mine, returning to Copper Cliff to spend the night.

Monday we went to the Naughton Station on the same line, and from there rode to and saw the company's property in Creighton township. Tuesday we visited the Stobie mine and the works of the Dominion Company, at the quarter section marked DuCharme on the map (enclosure No. 1), Sir Hussey Vivians Works at the Murray Mine and the Worthington Mine belonging to the Dominion Company at the point called Crean Mine on the map above referred to.

Next morning we started on our return via Sault Ste. Marie, visiting on the 10th inst., the shops of the Gates Iron Works and Fraser & Chalmers, manufacturers of mining machinery at Chicago, thence to Cleveland, Ohio, where we were again present at a meeting of the Board of Directors of the Canadian Copper Company, and on the 12th inst., returned to our regular stations.

Having thus briefly summarized our itinerary we have the honour to submit the following general observations upon the mining district of Sudbury, and a more detailed description of the special points we visited.

THE SUDBURY MINING DISTRICT.

The presence of extensive and promising tracts of mineral deposits in what is now called the Province of Ontario has long been known, and as early as 1846 a report was made to the Canadian Government stating this fact, but saying that owing to the difficulties of access and the cost of transportation working these deposits must be delayed until railways were constructed and freightage to markets thereby reduced.

Enclosure No. 2. A map published by the Canadian Pacific Railway Company shows the situation of this district and the lines of railway now finished, and it was not until the construction of this railroad that the great value of these deposits were even moderately estimated. Mr. S. J. Ritchie's relations to the Canadian Government were such that he could obtain advantageous terms, took out applications covering a

territory of about 100,000 acres, extending in a Northeasterly direction from Crean mine to Stobie, and embracing a belt of territory about 25 miles long, and from 3 to 7 miles broad, within which the mineral deposits were reported to lie. Upon a more careful examination of this district he selected first the territory shaded red from the Evans to the Stobie mine, paying the price fixed by the Canadian Government and there by acquiring the title, and suffering the remainder which he had preempted to revert to the State. The Canadian Copper Company which had been chartered January 6, 1886, (Capital \$2,000,000, afterwards, August 8, 1889, increased to \$2,500,000, under the laws of the State of Ohio, and granted by special Act of the Canadian Government all the rights that it would have acquired under a Canadian charter, subsequently purchased the tracts of land colored purple, green and yellow in Denison township; that colored red in Creighton, and the quarter section called Stobie and colored yellow on the map.

These in the opinion of the company, based upon reports of its surveyors and prospectors, cover all the profitable deposits in the district. All of the beds of ore seem to lie between the strata of granite on one side and diorite on the other, and as those formations generally, plainly appear on the surface, they have guided the company in its selection of territory. That the company has, however, secured all the deposits of ore in the vicinity is by no means clear to us; but we are fully convinced from the surface indications and the borings and shafts already sunk, that they have an amount of mineral which cannot be exhausted by this generation. The surface indications are found in the belt previously mentioned and although they seem in each bounded by the walls of granite and diorite, more careful examination of the country when it is opened out may discover other valuable deposits connecting those owned by this company,

The general character of this country and the neighborhood for hundreds of miles, is broken by rocky ranges from 100 to 600 feet high, the bare rocks cropping out in many cases and the rest covered by a thin soil, upon which were pine forests. Between the hills are marshy valleys and numerous lakes and streams capable of furnishing abundant water power. As yet there are no roads, excepting in the immediate vicinity of the railways, and the country accessible only on foot, except where trails have been cut to several points.

About 18 years ago forest fires swept the whole neighborhood, and the standing trunks of immense pines are surrounded by a second growth, which in the valleys is so dense as to be scarcely passable, and, with the fallen trees, slippery rocks and marshy land, renders even a prospector's task difficult.

The Canadian Copper Company claim to have spent thousands of dollars in surveying and prospecting, and as they had the right of selection, it is reasonable to suppose, that with the great capital at their disposal, they did not leave much to others. The properties of the same companies mentioned are at the extremities of the belt, and may be only the fringe of the main body of deposits. From our examination they appear to be in extent and capability hardly one per cent. of that owned by the Canadian Copper Co.

The Crean Mine at the S. W. extremity has been worked out and abandoned, and the Worthington Mine near the same seems to be only a pocket.

The Dominion Co's. mine at the other extremity seems to be nearly worked out; and the Murray Mine but comparatively small. Should other deposits be not found outside of the belt mentioned, the Canadian Copper Company would have practically everything. The others claim, however, to own large tracts of land to the north and northwest, but the existence of ores therein is disputed and seems to be doubtful. Neither company claims to be doing any work beyond prospecting at any points we did not visit.

The character of the ores in this district is technically described in the paper written by Dr. E. D. Peters, who was for a time manager of the Canadian Copper Company, and is annexed. (Enclosure No. 2)

It is important to notice from an economic point of view, that these ores can be smelted in their natural state, that is, they do not require the admixture of fluxing substances. The dead pine timber found in great abundance in the neighborhood and which can be delivered at the furnaces at \$1.80 per cord, is a good fuel for roasting, though hard wood would be better, but owing to the fusible qualities of the ores, and intermixed rock, it answers the purpose. Coke is then the only material that has to be brought from abroad. This is procured from Pittsburgh, and can be delivered at the works at \$7.00 per ton.

The general processes are :

- 1st.—Mining.
- 2nd.—Roasting.
- 3rd.—Smelting.

The points selected for mining are determined from surface indications, and by examination of the substrata by a diamond drill. This drill cuts a core from the rock through which it passes, thus furnishing material for analysis of the substrata.

The convenience of working and transportation are of course considered. Should the deposits of ore be in large quantities on a hill-side, it is simply blasted off but as they more frequently dip under the surface, mining by a series of levels is less expensive. A shaft is run at an angle determined by boring a convenient depth, and then the ore blasted out of a large chamber, the miners working around the walls and ceilings, standing on the mass already thrown down until the work on this level is exhausted.

The shaft in the meantime is continued to another level and another chamber worked as before. Shaft mining is also much better adapted to the severe winter climate than surface work and is alone sufficient reason for its adoption here.

The mass of rock and ore thrown down in the chambers is broken into handling sizes by the miners, the good ore separated from the rock and low grades, loaded into trucks, and hoisted to the crusher at the top of the shaft. Passing through this, it is divided by sieves into three sizes, and falls into bins respectively. Before and after crushing the "gangue" (non ore breaking rock) is picked out as much as possible.

The rock from the chambers and low grade ore are dumped into a heap at one side.

2nd—Roasting. Roast beds are prepared by levelling a surface on the ground, which should be well drained and hard. Upon this a thin layer of the "fines" is layed, then a layer of pine wood from one and one half to two feet in thickness, according to the fusibility of the ores; then "coarse" and "ragging" is laid on to a depth of about seven feet, and the whole covered over with fines to confine the heat. Fires are started and the mass burns from forty to seventy days, it is then broken up and transported into bins near the smelting furnaces.

3rd—Roasting. The furnaces are, speaking generally, vertical recepticals, into which combustion started at the

bottom is continued through successive layers of coke and ore, the mineral fusing and running off as matte at the bottom, and the feeding continued at the top, as the mass smelts down

Various qualities of ores are in bins at the level of the charge door of the furnace, and the successive charges of ores and coke are weighed and shoveled into the same. A cold blast at the bottom stimulates the combustion, and as the mass is fused it runs into a fore hearth from which the slag is drawn off at short intervals through a tap hole near the top, and the matte at longer intervals from the bottom.

Upon the disposition of the means of handling the material through its various stages, avoiding handling to the greatest possible extent, depends to a considerable degree economic production.

Having thus generally noticed the characteristics of the district, and the processes employed, we beg leave to give a detailed description of the mines and ore deposits as follows:

The Canadian Copper Cliff Co.:

The Cooper Mine and vicinity,

The Evans " "

The Stobie " "

The Vermillion "

The deposits in Creighton township.

The Dominion Mineral Company:

The Blezzerd Mine,

The Worthington Mine,

The Crean Mine.

The Copper Cliff mine is situated on a branch road, the property of the Canadian Copper Company, about a mile from Copper Cliff Station, about four miles from Sudbury on the Algoma branch of the Canadian Pacific Railway, and was opened in the summer of 1886. The face of the hill about 60 feet high was blasted off and a shaft sunk at 45° into the earth. The mining is now on the fifth level, and the sixth about to be opened, the length of the shaft being about 600 feet; 56,534 tons of ore have been taken to the roast yard from this mine from the opening up to the 1st of October, 1890. At present about 180 tons of ore are crushed daily. There are no indications of decrease in the extent or richness of the ore. It does not appear in veins, but the entire mass seems ore of varying grades, with small quantities of rock intermixed. As the depth is increased the percentage of nickel in the ore somewhat increased with a corresponding decrease of copper.

There is irregularity in the ore as to the proportions of the abovenamed minerals. one or the other predominating in spots in a way not to be predicted or accounted for.

The average amount of copper and nickel combined is about 8 per cent : six of copper and two of nickel. Specimens however, have been picked with copper running as high as 30 and nickel 15 per cent, but the presence of small deposits of abnormal richness can not be considered as indicative of the richness of the mine, as regularity promises greater extent of the deposits.

The plant consists of a hoisting engine, with two drums and cables, one No. 5 Blake crusher, 15 inches x 9 inches aperture with sieves for sorting ore, capable of crushing about 400 tons of the kind of ore taken from this mine in 24 hours. A steam pump and reservoir for compressing air for the rock drills a small machine for making repairs, two boilers, furnishing about 80 horse power, which suffices to run all of the machinery, one steam pump used at the lower level of the mine, which condenses into the tank it pumps from: one small pump run by compressed air for filling this tank, and four rock drills, also run by air. In addition are the ore trucks and utensils for blasting, breaking and handling the ore

Near this mine are the offices of the company, and about 40 log houses for the employes and their families. The ore from the bins under the crusher drops into dumping cars upon the railroad track, which connects with the roast yard. This track runs up grade on to a trestle work about a mile long leading towards the smelting furnaces. On one side of this trestle, the level of which is about 15 feet higher, the ground is levelled off for the roast beds about 2,000 feet along the track and from 15 to 75 feet wide. the ore from the cars falls through a chute in hand barrows, by which it is distributed over the beds. After roasting the ore is carried in hand barrows to a track running parallel to the other on the opposite side of the trestle, and on the level of the road beds. This track leads to the smelting furnaces and the ore is dumped into the bins thereat. The present capacity of the roast yards is about 60 000 tons. This can be easily increased to 90,000 by preparing the ground near it at small expense, and indefinitely by lengthening the trestle, and cutting into the hill sides at no great expense.

At the time of our visit about 35,000 tons of raw ore were in the roast yards. The work in the yards is done by contract, and at present about 75 men are employed. The company pro-

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vides fuel plant and tools, and the contract price is 20 cents per ton from bins and off cars on to the beds: and 30 cents per ton off beds into cars, and into bins at smelting furnace. Total from bins at the mines to bins at the furnace 50 cents per ton.

Working full power, the beds can be used about four times a year, that is, counting the times occupied in bedding, roasting and clearing the beds, it can hardly average less than three months. the full yearly capacity of the present yard is 240,000 tons. By additions that could be made in one month the yearly capacity could be increased to 300,000 tons.

All the roasting of the Canadian Copper Company will be done at this point.

In connection with the line of tracks from the main line, and roast yards are the smelting furnaces. The plant here consists of two Herreshoff Water Jacketed furnaces, with two complete sets of blowers, either of which has sufficient power to supply the blast for both furnaces.

The two levels of tracks are conveniently disposed for economical handling, the upper level dumping into the bins, on the level of the feeding platform, the roasting ores, raw "fines" and "coke," and the lower taking away the matte, loaded from where it lies level with the platform of the cars.

The Herreshoff furnaces are an American patent, and said to be the best used. One has reduced 187 tons of the ore from these mines in one day, and the manager and furnace man said that, running without forcing, 135 tons could easily be reduced. English furnaces of the same size do not reduce more than 50 tons per diem.

The Manager and Chemist at the works said the average of the last month's production was that about 6 tons of ore produced one ton of matte. The directors say that the records of the office show that, since the smelting works were started about five tons of ore produced one ton of matte.

The ores from the three bins are smelted here, the Company having no other furnaces, and they are combined so as to smelt readily. One ton of coke is used for every ton of matte run off.

At the time of our visit only one furnace was running the other was repairing, the average daily production of matte for the last month was 25 tons. Mr. Ritchie said the Company was contracting for ten furnaces of similar design. These would be built in Canada, if they could be built in the desired

time, if not, all or part from the United States. He said they could be built, delivered and set up within six months.

The full capacity of the two furnaces per diem would be about 60 tons of matte. The matte averages about 17 per cent nickel and 25 per cent copper.

The daily output of nickel at this rate 10.2 tons, and for ten furnaces at the same rate 50.4.

There is at present about 6,500 tons of matte ready for delivery, and the ore on the roast beds will produce about 6,000 tons more, containing 1105 and 1020 tons of nickel respectively.

To run one furnace the following men are required :—

One weigher,
Two engineers,
Two furnace men.
Two slag wheelers,
Two chargers,
One yard man

Total, ten men at an average pay of \$1.80 per diem.

Attached to the furnaces is a well fitted laboratory with F. L. Sperry, chemist, in charge, and two assistants. Here each run of matte is analysed and assays made of ores as needed.

The whole disposition of the plant is well planned for working with economy, and it will be observed that the ores are handled but four times: 1st, into the cars from the mines 2nd, into the crusher, 3rd, off the roast-beds, 4th, into the furnace, at other operations it falls by gravity into or from the bins or cars.

To increase the plant, the company has purchased a Gates Crusher from the Gates Iron Works at Chicago, and it with its accessories, is now on the grounds ready to be set up. It is the largest size they make (No. 8,) and with three apertures 18 inches by 42 inches each and its capacity is stated in the catalogue of the makers 100 to 150 tons per hour. Mr. Gates, whom we saw in Chicago, stated that it would crush 200 tons of the friable ores, of Sudbury per hour. This will give a total per diem capacity at the Canadian Copper Company's mines of 6,000 tons.

THE VICINITY OF THE COPPER CLIFF MINE.

Starting from the hill into which the shaft of this mine is sunk, we rode over a range of hills to the point named on the map "McConnell Mine," a distance along the range of about $2\frac{1}{2}$ miles. On the hill just back of the shaft of the Copper

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Cliff Mine, borings have been made all finding good ores. One was sunk to a depth of 291 feet at 15 degrees from perpendicular and the core extracted showed good ore for 226 along this length. Following along the ridge, which we estimated was from 100 to 250 feet above the level of the valley at Copper Cliff and from 300 to 1,000 feet broad at base, the surface indications are continuous. At the Lady Macdonald Mine, and the McConnell Mine the hills of ore were most conspicuous and at places of each the surface had been blasted away to a depth of several feet where rich ore unaffected by exposure was found. The surface indications are so evident that no expert knowledge is needed to pick out the ore bearing rock, which is reddish brown, and quite friable, very different from the granite and diorite ranges which bound it. The assays of both the above mines show rich ore, better than at Copper Cliff, and in the case of the Lady Macdonald, blasting at the top of the hill and about 150 feet lower at the small lake finds good ore, leading the prospectors to assert that the hill was a rich mass through out.

From this range to Stobie Mine, the land is lower and the country hardly passable. We are told that surface indications at various points connected these with the range of Stobie deposits three miles to the north east. We did not attempt to ride through this country.

Specimens from the various points blasted out were procured on the spots, and can be analysed if the Department so directs.

The Evans Mine is situated about $1\frac{1}{2}$ miles S.W. of Copper Cliff Station, near the Algoma Branch of the C. P. R., and is connected therewith by a half mile of track owned by the company. It was opened in the summer of 1886, but work was not pressed, and in 1887 only a depth of 20 feet was reached. Now the shaft runs down to a second level of 186 feet from the collar of the shaft. The first level has been blasted to the surface, and a large pit about 90 feet deep and 200 feet in diameter is exposed. The sides appear to be for the greater part, ore, and no limit has yet been reached.

The mining plant here is practically the same as at the Copper Cliff. The hoisting machinery, however, is somewhat heavier, and the steam power is provided by a battery of four boilers, capacity of 22 O. H. P., of which two are sufficient to run the plant. The crusher capacity is the same as at Copper Cliff, about 400 tons maximum per diem, 32,817 tons of ore are

been taken from this mine to roast previous to October 1st, 1890. At present about 180 tons are crushed daily.

The grade of the ore is not quite as high as at Copper Cliff, and averages about 7 per cent. Some roasting has been done here, but in future all the ores will be taken to the main roast yards. A short line about one half mile, connects with the main line and facilities for handling ores are the same as at Copper Cliff.

THE VICINITY OF THE EVANS MINE.

A granite range between the hill now worked at Kelly Lake seems to bound the deposits in a south-westerly direction. The company owns the lots which are shaded by hatching in addition to those colored red on the map. Surface indications are found to the north connecting with the Copper Cliff range, and the hill halfway between has promising deposits; thence across the valley to Copper Cliff are no surface indications nor have any borings been made, but it is thought that the bed of ore connecting the two may be found at a moderate depth.

The Stobie Mine is situated about three and one-half miles north of Sudbury, near a branch of the Canadian Pacific Railway built to serve this and the Blezzard mine, and connected therewith by a one fourth of mile of track owned by the Canadian Copper Co. It was opened during the summer of 1887 by running two tunnels horizontally 100 feet into the hill-side about 150 feet apart, both of which developed excellent ore. Since then mining has been carried on by simply blasting off the face of the hill to about 50 ft. depth and 300 ft. across the face. No limit to the deposit has yet been reached, 15,790 tons of ore having been carried from this mine to the roast yard up to October 1st, 1890, and the daily average at present is 110 tons.

The mining plant is about the same as at the Evans mine, one Blake No. 5 crusher, drilling and hoisting machinery.

The blasted rock is broken up in the pit, loaded by hand into buckets which are dumped into trucks, hoisted up an incline to the crusher, and thence passing to the bins.

The percentage of nickel and copper at this mine is smaller than either of the others, hardly averaging above 5 per cent., but several pockets very rich in nickel have been worked.

The ore is remarkable for its fluxing qualities, and forms a valuable mixture to smelt the less fusible ore of the other

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mines, and entirely obviates the necessity of the addition of any foreign fluxing substances.

The crushed ore is carried on cars to the roast yard at Copper Cliff.

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THE VICINITY OF THE STOBIE MINE

Stobie is, in the opinion of the Canadian Copper Co., the northwest limit of the valuable belt of ore deposits passing over the hill now worked which is about 90 feet high and about 600 at the base and seems almost entirely a mass of ore, and over a valley a ridge is found extending to the southwest in the direction of the Lady Macdonald mine. The range is almost bare of timber, and the deposit could be easily seen. We were told the length of the range was two miles, but we did not take time to go over the whole of it. The height is estimated from 50 to 100 feet above the level of the R.R., at Stobie, and from 300 to 1000 across the base of the mounds forming the ridge.

THE VERMILLION MINE AND VICINITY.

By this we mean that portion in Denison Township shaded yellow and purple on the map. To reach it, it was necessary to ride over a trail from Whitelash Station as shown by arrows on the map. After leaving the fork to which a cart might have passed, there was nothing but a path through the woods, difficult of access on horseback. The first surface indications were at the commencement of the ridge sketched on the map where the trail turned to the left. Here the indications of ore were unmistakable, and across the valley to the north of the small lake, was a large hill of the ore.

Along this ridge we rode for nearly three miles following a continuous line of surface indications, the most important of which was Crean Hill. It is hard to estimate the extent of this deposit, the country was covered with undergrowth and the ascents and descents over the ridges were precipitous. We should judge, however, that the base of the ridge averaged at least 500 feet, and that the hillocks were from 150 to 300 feet high, the surface showing the evident appearance of ore-bearing rock.

Crean Hill was stated by the guide to be 300 feet above the level of the lake near by, and we should judge it not over-estimated. The base of the mound was over 1200 feet.

A sample of ore was taken in our presence, from the unbroken surface which assayed 26 per cent copper and one of nickel.

Passing down from this ridge we came to a valley between it and the nickel hill on the map marked 'Gold Mine.' At the upper end of this a half mile from the lake is the Vermillion mine. This was worked by a company for gold, a shaft sunk to about 60 feet and then abandoned. We found the shaft filled with water. Here and along the trail to the fork in the road quartz crops out at intervals with indications of gold. An Arsenside of Platinum, a metal heretofore unknown, has been found here. It was brought to the attention of the metallurgists by Mr. Sperry and named 'Sperry-lite.' It is found by washing the sand, and the assays of the sand in this valley have shown as high as 70 ounces of platinum per ton. The extent and value of this was not realized by Mr. Ritchie previous to this visit, and his observation at this time will probably lead to the development of this tract.

At the top of the hill on the other side of this valley a shaft had been sunk from which a quantity of ore extremely rich in nickel had been taken. Specimens have assayed up to 40 per cent. of this material. From two heaps of several hundred tons each a number of specimens were taken and sent to the Department as samples. They will probably be found to contain a high percentage of nickel. Whether the limit of this pocket had been reached we cannot say. The man living near in charge of the place and the prospector with us said not. The distance from the railroad and impossibility of transport may be the reason of not previously developing a mine which promises so well. On our return to Whitefish Station we met a Mr. Ahn, who is setting up assaying works in the neighborhood, who came to see Mr. Ritchie regarding the richness of the valley near the Vermillion mine. This tract was not purchased by the Canadian Copper Co. until this year, though they claim to have had previously a part ownership.

THE DEPOSITS IN CREIGHTON TOWNSHIP.

These we reached from the railway above Naughton Station by a ride of five miles through an almost inaccessible country.

The size of the deposit is far more striking than any we visited. It is a mound of the general dimensions shown in this sketch, the dimensions of which are estimated. The height of the mound is taken from the level of a body of water as indicated on the map. The hill, over the greater part of which we rode, seems to be entirely ore bearing rock, Mr.

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Ritchie claims it to be the largest visible body of ore known. He had scarcely seen it before and had no idea of its extent. He has already given orders to cut a road into it immediately, and to survey for a railway line to be run from Copper Cliff, or a convenient point, on the Algoma branch of the Canadian Pacific Railway. No assays have been made of the ore of this deposit, and we can only say that the indications of an immense deposit were more striking here than at any other point.

This property was acquired by this company in 1886 and 7.

THE DOMINION MINERAL COMPANY.

The Blezard Mine. This, the principal mine of the company, is situated on a branch built by the Canadian Pacific Railway, and owned by it, in the quarter section marked "DuCharmb" on the map, and colored yellow. It is about four and one-half miles north of Sudbury, and it is the northern extreme now worked or known to us to exist. The Canadian Copper Company claim to have had this property at their option for two years, and to have rejected it as not worth acquiring. We have read a report made by this Company by Mr. J. D. Evans, a surveyor and at present the manager of the Canadian Copper Company's works, who appeared a most efficient and trustworthy man, in which he states that he did not consider the property worth working. Three shafts are sunk into the hill vertically, about a hundred feet apart. The main one is sunk about 90 feet, and the chambers worked from this level. They extend for about 200 feet in each direction, and the manager said that since July 15, 1889, 45,000 tons of the ore had been taken out. The rumors in the neighborhood are that the mine had been worked out, but they were from competitive sources. The chambers seem well cleaned from ore, and though lighted by electricity, we could see but few evidences of active mining. Mr. Evans said that the floor of the chamber was rock. The manager claimed a daily product of 180 tons of ore; that it took from 9 to 12 to make 5 of matte and that this averaged from 20 to 30 per cent nickel and from 12 to 15 per cent copper.

The hill which was being worked was about 100 feet high and about 500 feet in diameter. We saw no evidence of other deposits near, and the manager claimed none. The plant is excellent, and copied after that of the Copper Cliff mine in the

selection of machinery. One Blake No. 5 crusher, and rock drilling and pumping machinery of the same pattern as before mentioned—the whole rather better installed than at the Copper Cliff Mine. The roast beds, however, were placed all about the grounds and could not be so economically handled. We counted 26 heaps in all and estimated there was about 13,000 tons of ore upon them.

In the smelting works is one furnace similar to those at the Canadian Copper Company's works, with similar accessories. They had not more than ten tons of matte on hand, in two heaps, which they claimed to assay 30 and 33 per cent of nickel. We procured samples from each pile which can be assayed if the Department directs. The manager claimed that the company owns 5,000 acres of land upon which were 9 places they contemplated working, 6 for copper and 3 for nickel. He spoke of the Worthington Mine as being the richest, and gave us a sample of ore which he claimed would assay 40 per cent nickel. He said that one shaft had been sunk 72 feet (Crean Mine) one 25 feet (Worthington Mine) and at four other places cross-cuts had been blasted. Although the deposits at Crean Mine as shown on the map had been represented to us as worthless owing to his representations we visited them.

The Worthington Mine is situated on the Algoma branch of the Canadian Pacific Railroad, about 7 miles west of Whitefish Station. We found a mound about 30 feet high and 50 in diameter with a small shaft sunk in the middle about 25 feet deep. From it had been taken a few tons of ore, which appeared quite rich in nickel. The man in charge, however, said it appeared to be only a pocket and that the end had been probably reached. He mentioned one very fine specimen of ore, half of which he had sent to the principal office, and showed us the other half of the piece we had in our possession. As the property is alongside a railroad, now seven years in active operation, it seems reasonable to suppose that it does not pay to work.

The Crean Mine is within a few hundred feet of the Worthington. The shaft was sunk by previous owners to a depth of about 70 feet, and was abandoned as unprofitable. No work has been done on it since.

The Murray Mine is situated on the main line of the Canadian Pacific Railroad, two and one half miles N.W. of Sudbury. Mr. Ritchie claims that this mine was also at the

option of the Canadian Copper Co., and rejected. The railway cuts through the deposits. On the left side is a hill about 75 feet above the track and extending about 300 feet perpendicular to and 150 feet along the same. This embraces all the deposit claimed on this side of the railroad. On the other is a mound about 15 feet high, and extending 100 feet perpendicular to and 70 feet along the track. Both of these are evidently ore bearing rock. Beyond the mound on the north side of the track, across the marsh about 100 feet wide, another small deposit was visible, which the manager claimed extended to the N.E. for miles, he knew not how many. They were making no preparation to work these latter deposits and their existence is disputed. The manager says another Company owns the section north of them, but beyond that they owned a large territory.

There is one shaft sunk in the hill on the south side of the track to a depth of 60 feet, and from this they are taking small quantities of ore, which is handled in hand-barrows. They have a small crusher of not over 75 tons capacity per diem. The furnace is of the English pattern, the same as used in the company's works at Swansea, England. It can reduce about 40 tons of ore per diem, and has been in operation about three weeks. Another similar but larger furnace is building. The works are not economically planned for working on an extensive scale.

Eight thousand tons of ore have been mined in the last year and a half since the mine was opened. The ore runs about two per cent of copper and nickel.

The matte is 8 per cent nickel and 4 per cent copper. The manager said he had orders to mine 40,000 tons next year. The place cannot in any way be considered as a competitor of the Canadian Copper Company.

GENERAL SUMMARY.

	Canadian Copper Company.	Dominion.	Vivian's.
Acres owned known to us	18,000	480	320
Additional claimed.....		5,000	4,000
Amount of ore taken from mines to October 1st	105,000	45,000	8,000
Daily furnace capacity, matte.....	72	14	5
Daily crushing capacity, ore.....	1,200	400	150
Estimate of tons of ore above surface of ground in deposits seen by us	650,000,000	2,500,000	240,000

We visited the Fraser and Chalmers Co., and the Gates Iron Works in Chicago, where the various statements concerning the capacity of the plant and embodied in this report were verified.

Very respectfully,

WM. M. FOLGER,

Commander U.S. Navy.

B. H. BUCKINGHAM,

Lieutenant U.S. Navy.

